EB1935

Jointed Goatgrass Control Tactics

Many winter wheat producers in the western United States rank jointed goatgrass as the most troublesome weed they must manage. Jointed goatgrass competes with a wheat crop, resulting in reduced yield and increased grain dockage. Genetic and life cycle similarities between jointed goatgrass and winter wheat makes jointed goatgrass control difficult.

Managing jointed goatgrass in winter wheat requires a systems approach that integrates multiple control tactics into a comprehensive management plan covering multiple years. This bulletin describes control tactics that can be used as part of integrated management systems to control jointed goatgrass. Similar control tactics are grouped into categories, such as seed bank management or prevention (Figure 1).

Jointed goatgrass infestations are seldom recognized before the problem is out of control. However, early awareness of the problem is essential for its control. Accurate identification of jointed goatgrass spikelets and plants in various growth stages is critical to early detection. Jointed goatgrass identification is a challenge because the weed is similar in appearance to winter wheat. However, there are differences. Jointed goatgrass seedlings have evenly spaced hairs lining the leaf blade margin and winter wheat does not. The jointed goatgrass seed, often referred to as a spikelet or joint, is distinctly different from wheat and can aid in identification. EB 1932, "Jointed Goatgrass Ecology," plant identification guides (books, pamphlets and web-based publications), and local extension specialists are excellent resources to help identify jointed goatgrass.

Prevention

A critical aspect of jointed goatgrass management is to prevent seed entry into fields and isolate minor infestations within the field. Jointed goatgrass seeds are usually enclosed within a spikelet, which resembles a short piece of wheat straw and is easily overlooked in bulk grain (Figure 2). Planting wheat contaminated with jointed goatgrass spikelets rapidly expands the area infested with jointed goatgrass. Moreover, contaminated wheat seed will be planted over entire fields or farms, making isolation difficult. Planting jointed goatgrass-free seed can prevent the initial infestation and reduce or help stop the spread of an existing problem.

Figure 1. Various control strategies can be used to reduce jointed goatgrass densities. Integrating multiple strategies into a management plan reduces jointed goatgrass populations more than use of single strategies alone.

Figure 2. Jointed goatgrass spikelets (seed) resemble wheat straw, are difficult to separate from wheat grain, and increase dockage at the grain terminal.

Field borders, roadsides, railroad tracks, and other rights-of-way should be inspected for jointed goatgrass and control measures applied if necessary. Once plants establish along these areas, spikelets can move into crop fields by precipitation runoff, tillage implements, or animals.

Farm trucks are commonly used for multiple purposes, such as hauling harvested grain, fertilizer, and bulk seed wheat. Thoroughly cleaning trucks and equipment used for grain or fertilizer hauling between different uses is a good management practice. If contaminated seed or fertilizer is used for planting crops other than winter wheat, jointed goatgrass seed could remain dormant and establish in a subsequent winter crop.

As a load of wheat contaminated with jointed goatgrass travels down the road, jointed goatgrass spikelets migrate towards the top of the load because they are lighter than wheat seeds. Once they have moved to the top of the load, the spikelets are easily blown out of an uncovered load and fall along the roadside. Covering loaded trucks or wagons thought to contain contaminated wheat is a good management practice and a good neighbor policy.

Movement by machinery also spreads jointed goatgrass within and between fields. For example, combines can rapidly disperse jointed goatgrass seeds throughout a field (Figure 3). Scientists in Australia evaluated seed dispersal of wild oat and downy brome (also called cheatgrass) and found that combine seed dispersal increased the area of infestation 16-fold in only one year, compared with a system where seed dispersal at harvest was prevented.

Field scouting can identify areas in fields that may be infested with jointed goatgrass. Jointed goatgrass commonly occurs in patches within fields. Harvesting these patches along with weed-free sections of the field will disperse jointed goatgrass into non-infested areas. Those areas should be marked and harvested last so that seed dispersal within the field will be minimized. Equipment should be cleaned before moving from infested fields. Custom harvesters should be required to clean combines and trucks prior to entry into fields.

Harvesting contaminated field edges with a combine will spread jointed goatgrass seed throughout the remainder of the field. Perennial grasses could be maintained around field edges or borders to reduce jointed goatgrass establishment and seed production. However, it is also important to avoid grasses that can provide refuge for wheat pests, such as aphids or the wheat curl mite. Please contact your local state extension specialist for additional information on perennial grass species adapted for your area.

Mowing. Mowing can be a useful tool for managing jointed goatgrass infestations in

Figure 3. Jointed goatgrass can be easily spread through normal harvest operations.

roadsides, fencerows, and non-cropland areas, but timing is essential. Two separate cuttings at specific times in the season may be required to prevent jointed goatgrass from producing seed. Mowing is most effective when jointed goatgrass seed heads begin to emerge. Mowing too late may allow jointed goatgrass to produce viable seed. However, mowing too early (early joint stage) may allow jointed goatgrass plants to regrow and produce seed. Because of variable effectiveness, mowing is not recommended for jointed goatgrass control in a field situation unless it is the only alternative.

Another option is to not plant the outer edge of the field to winter wheat, but to leave this border fallow until a spring small grains or summer crop can be planted. This method may also provide greater revenue. An alternative crop in these areas also allows tillage or herbicides to be used in the spring to control jointed goatgrass. However, a disadvantage is that the alternative and winter wheat crops may not mature at the same time, requiring a second trip to harvest the alternative crop.

Feeding Jointed Goatgrass to Livestock. Wheat contaminated with jointed goatgrass seed is often heavily docked or rejected by grain purchasers. Scientists in Nebraska investigated jointed goatgrass-contaminated wheat as a potential livestock feed. Jointed goatgrass seed contains a protein content near 12% and they found that it makes a suitable alternative for livestock feed. Feed mixtures containing jointed goatgrass must be processed in a fine-grind hammer mill to eliminate the germinability of the jointed goatgrass seed. Failure to do so may result in a larger weed problem if seed is spread in livestock manure.

Herbicides

Non-Selective. Many postemergence non-selective herbicides, such as glyphosate, can control jointed goatgrass and other winter annual grasses found in fallow fields. Check product labels or consult with your local crop consultant, extension specialist, or pesticide retailer for specific recommendations in your area. Burndown herbicides used in no-tillage cropping systems should be applied early enough to allow complete jointed goatgrass control before planting the subsequent crop.

Selective. Selective herbicides are available in other crops to control jointed goatgrass, but are not currently registered for use in conventional (non-herbicide resistant) winter wheat. Jointed goatgrass is genetically related to winter wheat and cannot be controlled by herbicides without causing unacceptable crop injury. Finding a herbicide that would control jointed goatgrass in conventional wheat is unlikely, given the high cost of developing and marketing such a product. Current industry efforts are focusing on herbicide-resistant wheat technology.

Clearfield Wheat Technology. The recently developed Clearfield™ wheat system offers growers an effective method to selectively control jointed goatgrass in herbicide-resistant winter wheat. Clearfield™ wheat varieties are rapidly being developed that combine herbicide tolerance to imidazolinone herbicides with desirable traits from current wheat varieties. This technology allows Beyond™ (imazamox) herbicide to be used for control of jointed goatgrass and other weeds in wheat.

Beyond™ herbicide should be applied early postemergence to Clearfield™ wheat between the three-leaf stage and prior to jointing at rates specified by the product label. Applications should be made when maximum daytime temperatures are greater than 40 ℉ to optimize weed control and reduce potential crop injury. Weeds should be actively growing and less than 3 inches tall. Refer to the Beyond™ product use label for proper adjuvant systems. Conventional (non-Clearfield™) wheat varieties will be seriously injured or killed if sprayed with Beyond™ herbicide. Beyond™ can be applied in the fall or spring, but the optimum application timing is region-specific. In addition to controlling jointed goatgrass, Beyond™ controls several other winter annual grass and

broadleaf weeds. Region-specific application information, Clearfield™ wheat seed varieties, and costs are available through local agricultural product retail centers.

Clearfield™ wheat varieties must be locally adapted. In the Pacific Northwest, for example, a farmer may be better off to plant a locally adapted spring wheat to prevent a jointed goatgrass infestation than using a poorly adapted Clearfield™ variety as part of a management program. Producers throughout the western United States will have access to improved Clearfield™ wheat varieties within the next few years.

Seed Bank Management

Tillage to Stimulate Germination. Jointed goatgrass management is complex because seed survival in the soil can vary depending on annual rainfall. If seed numbers in soil can be reduced, then fewer seedlings will infest future winter wheat crops. Producers often observe flushes of seedlings soon after tillage, which can stimulate jointed goatgrass seed germination in the soil. Germination reduces the density of remaining seeds in the soil, but tillage may prolong the survival of some remaining seeds by burying them in soil and protecting them from environmental extremes and surface-feeding predators.

Scientists in Utah, Oregon, and Nebraska tested the effect of shallow tillage as a management option. Tillage operations were tested throughout the emergence period of jointed goatgrass, which generally occurs between September and April. No-till, single, and multiple tillage operations were evaluated and jointed goatgrass densities recorded in the following winter wheat crop.

The scientists concluded that single or multiple tillage operations were inconsistent in reducing jointed goatgrass seed bank density. Environmental conditions, especially timing and amount of rainfall, were more important than tillage in these studies. Differences among treatments were small at all sites, suggesting shallow tillage exerts a minor effect on seed bank density over time. Similar results have been reported in Kansas and Colorado. These studies suggest tillage may not be effective for managing jointed goatgrass seed in the soil. Producers will reduce jointed goatgrass infestations more with diverse crop rotations, competitive wheat canopies, and Beyond™ herbicide than with tillage. Tillage is not only inconsistent for managing jointed goatgrass, but can increase vulnerability to soil erosion. Tillage reduces straw residue remaining on the soil surface, increasing the risk of wind or water erosion.

Managing Fields with High Jointed Goatgrass Densities. Jointed goatgrass infestations in cropland may become so high that producers rely on extreme measures to reduce seed density in the soil. One option is to burn winter wheat residue lying on the soil surface after harvest. If sufficient heat is generated, burning will kill jointed goatgrass seeds. The effectiveness of this strategy is related to the quantity of residue (fuel load), with at least 5,000 pounds of residue per acre required to reach lethal temperatures. Jointed goatgrass seedling density in the following year can be reduced 80 to 90%. However, burning residue only kills jointed goatgrass seeds lying in residue on the soil surface; seeds buried in soil are protected from the lethal heat. A further consequence of burning is that soils are more prone to erosion when crop residue is removed. Field burning may also be prohibited or restricted in some areas. Always follow applicable laws and obtain necessary permits prior to burning.

A second management option is moldboard plowing (complete soil inversion), as jointed goatgrass seedlings cannot emerge after germination if buried at least 6 inches deep. Moldboard plowing can bury up to 90% of seeds laying on the soil surface deep enough to reduce seedling density in the following winter wheat crop. Shallow tillage after deep plowing will reduce the risk of bringing jointed

goatgrass seeds back to the soil surface where they can germinate.

Do not moldboard plow more than once every four years or the benefits of plowing will be minimized. Most jointed goatgrass seeds do not survive longer than four years when buried deep in soil, but may survive longer in drier soil conditions. Therefore, moldboard plowing in shorter intervals (less than four years) may bring live seeds back to the soil surface. Moldboard plowing, as well as burning, may be most useful for small areas of dense infestations, but eliminates surface residue and can make soil more susceptible to erosion. Given potential restrictions in burning or moldboard plowing, farmers will want to carefully evaluate which fields will benefit most from these management practices.

Crop Management

When winter wheat and jointed goatgrass grow together, the plants emerging first will capture resources such as water or nitrogen in the soil and will gain a competitive advantage. Producers can favor the competitiveness of winter wheat over jointed goatgrass with cultural practices that stimulate rapid emergence and vigorous seedling growth. For example, deep-banding nitrogen fertilizer near winter wheat seed at planting can stimulate the wheat and reduce jointed goatgrass growth up to 15%. Also, banding a small amount of phosphorus fertilizer with the seed can stimulate wheat seedling growth, even in soils with adequate phosphorus levels.

Improved Planting Techniques. Planting larger wheat seed can also increase wheat seedling size and vigor. Planting 50% more seed than standard recommendations and using a row spacing of 7 inches or less can also increase crop competitiveness with weeds. Similarly, planting winter wheat cultivars that are taller, tiller more profusely, and initiate growth earlier in the spring can reduce jointed goatgrass growth by 5–25%. Increasing seeding rates and using narrow row spacing works best in areas that receive at least 20 inches of annual rainfall. These practices should be used with caution in low rainfall areas and during periods of drought, as excessive early crop growth can deplete soil moisture needed later for grain fill.

Relying on a single cultural practice in winter wheat is an ineffective approach towards managing jointed goatgrass. Jointed goatgrass suppression seldom exceeds 25% when using individual practices such as using a higher seeding rate, planting larger-sized seed, planting in narrower rows, or banding phosphorus with the seed at planting. In addition, the effects of specific cultural practices are not consistent over years, varying with environmental conditions and jointed goatgrass emergence timing relative to wheat. Jointed goatgrass that emerges before, simultaneously, or within one week after wheat emerges will be the most competitive. Any condition that decreases wheat density or slows wheat growth will decrease the effectiveness of cultural control practices. For example, drought conditions that delay wheat emergence and reduce wheat populations will allow jointed goatgrass to flourish.

Integrating several tactics will suppress jointed goatgrass more than single cultural practices implemented individually. Winter wheat competition with jointed goatgrass in Colorado was increased six-fold by combining a tall cultivar with higher seeding rates and nitrogen placed in the crop row. When combined with a tall cultivar and a 40% increase in seeding rate, fertilizer placed directly in the seed row at planting reduced jointed goatgrass seed production nearly 45% compared to a broadcast nitrogen application. However, placing nitrogen fertilizer in the seed row can lead to injury of germinating crop seeds in most regions and is not considered a good management practice.

Not all jointed goatgrass will be controlled with cultural practices and surviving plants can produce many seeds, even with improved cultural systems. Multiple practices must

be combined in an integrated management program and sustained over time (years) to be effective against jointed goatgrass.

Crop Rotations

Most jointed goatgrass problems are found in areas where winter wheat-fallow or continuous wheat are common crop rotations. Implementing a winter wheat-fallow rotation alone will not provide a means to break the natural life cycle of jointed goatgrass, nor deplete the level of jointed goatgrass seed in the soil. Producers can reduce jointed goatgrass seed density in the soil by rotating from winter wheat to crops with different growth requirements, such as spring or summer crops. This tactic lengthens the interval between winter wheat crops, thus favoring the natural decline of jointed goatgrass seed density in the soil. About 30% of jointed goatgrass seeds are alive after two years in the soil, but fewer than 10% of the seeds typically survive for three years. EB1932, "Jointed Goatgrass Ecology," provides additional information on seed survival.

Producers in the Pacific Northwest have utilized the positive impacts of crop rotation on jointed goatgrass management by adding barley or spring wheat to a continuous winter wheat or winter wheat-fallow rotation. However, one limitation with spring small grain cereal crops is that jointed goatgrass plants may still become established in these crops, produce seeds, and lessen the effect of crop diversity. Adding pea, lentil, canola, or mustard to the crop rotation is more effective because the growing season is different than for jointed goatgrass and selective grass herbicides can be used, if necessary, to control jointed goatgrass.

In Utah, adding safflower to the winter wheat-fallow rotation is effective because producers can control jointed goatgrass both before planting and during the season safflower is grown (Figure 4). In the central Great Plains, producers can include summer annual crops such as corn (maize), sorghum, proso millet, soybean, or sunflower in the rotation (Figure 5). The later planting dates of these crops enable producers to eliminate any jointed goatgrass that emerged during the previous winter by using tillage or applying herbicides. By using rotations that include two summer

Figure 4. Adding safflower to the winter wheat-fallow provides an option for producers to reduce the seedbank density of jointed goatgrass while maximizing profitability.

annual crops in a winter wheat-fallow rotation, such as winter wheat-corn-sunflower-fallow, producers have nearly eliminated jointed goatgrass in most fields. An option in the southern Great Plains is to add sorghum to the winter wheat-fallow rotation. The positive impacts of using different crops in rotation for jointed goatgrass control must be balanced with economic feasibility.

Integration of Multiple Control Tactics

A variety of control tactics are available to help producers manage jointed goatgrass. A key lesson learned from years of research with jointed goatgrass is the need for integrated management systems comprised of several tactics. Effective management requires implementing practices from all possible control categories. Jointed goatgrass density has been reduced more than 90% with regional integrated management programs where multiple tactics were used in three- or four-year crop rotations. Scientists continue to evaluate the effects of comprehensive management systems on jointed goatgrass. Producers are encouraged to review other jointed goatgrass bulletins that describe the Best Management Practices (BMPs) for their region, or visit the National Jonted Goatgrass Research Program website at www.jointedgoatgrass.org.

Figure 5. Summer annual crops, such as grain sorghum, offer Great Plains producers an opportunity to add crops with a different life cycle to the winter wheat-fallow rotation.

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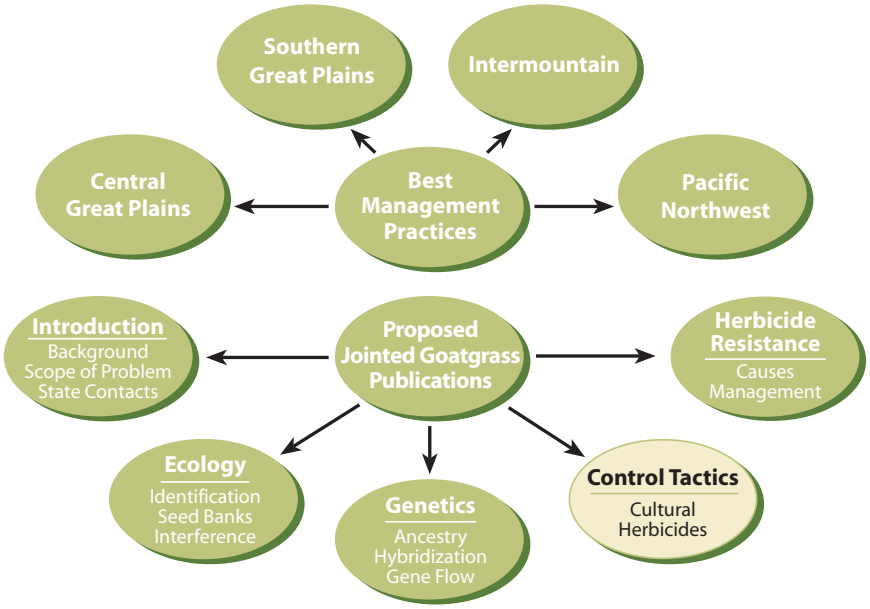

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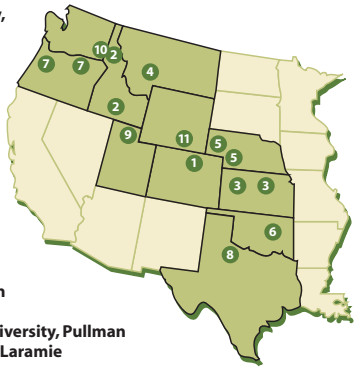

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